Remarks

Entry of the amendments presented herewith, reconsideration of the application and allowance of all claims are respectfully requested. Claims 1-41 remain pending.

In accordance with 37 C.F.R. 1.121(c)(1)(ii), a marked-up version of the amended claims is provided on one or more pages separate from the amendment. These pages are appended at the end of the Response.

Before discussing the claims at issue, applicants wish to gratefully acknowledge the indication of allowable subject matter in dependent claims 3-6, 9, 29 & 30 if rewritten in independent form including all limitations of the base and any intervening claims. These claims have not been rewritten herein, however, since the independent claims from which they depend are believed to recite patentable subject matter for the reasons stated below.

Applicants have amended the independent claims to clarify that the "still frame" and "still macroblock" comprise a frame and macroblock with content substantially identical to content of a preceding frame or a corresponding macroblock in a preceding frame. Thus, the phrase "sequence of still frames" as defined in the present application and used in the claims, is distinguishable from the interpretation given the phrase in the above-referenced office action. Applicants recognize as suggested by the

Examiner that each frame in a sequence of frames is just that, a frame itself. However, the phrase "still frame" or "still macroblock" is used in the present application to mean that the content does not substantially vary from one frame to another, that is, that a particular frame has little or no pixel difference with the frame preceding it. For example, a pixel difference of less than 1% might be defined by one skilled in the art to comprise a still frame relative to the preceding frame.

By way of further explanation, one specific definition of a "still frame" is an input frame to an encoder whose pixel data does not vary by either value or position with respect to the temporally previous frame input to the encoder. That is, frame i+1 contains identical pixel data to frame i for the entire frame. An example of such a still frame would be that the exact same picture is being fed into the encoder over a period of time.

As a further example, a partially still frame may comprise an object or objects within an input frame to an encoder whose pixel data does not vary by either value or position with respect to the same object or objects contained within a temporally previous frame input to the encoder. That is frame i+1 contains identical pixel data for an object or objects contained within the frame to the identical object or objects contained within frame i. An example of a partially still frame would be a series of frames whose background is constant, say a tree or house, which does not move or change position, although an object

or objects in the foreground may, such as a car driving by the house.

The meaning of "still frame" is significant to the present invention. The problem addressed by the present invention is the existence of "pulsation artifacts" which may occur after decoding of a series of encoded still frames. As used in the present application, "pulsation artifacts" is the result of encoding and decoding processes on successive substantially identical frames (i.e., still frames). Due to slight variations in the details in the encoded frames, visually apparent fluctuations in the decoded and displayed images may occur. These differences may give the impression of motion, and are known in the art as pulsation artifacts. Thus, while the initially received sequence of video frames may comprise a series of identical "still frames" in raw data format, after the still frames have undergone lossy compression and decompression (i.e., encoding and decoding) there may visually appear artifacts in the ultimately displayed image resulting from the lossy compression and decompression of the images. The present invention is directed to minimizing these artifacts with display of the ultimate image. Again, because of the compression techniques used, a video image that is identical or substantially identical to the previous and next images may not be displayed identically after decompression of that image. Variations in, for example, luminance and/or chrominance data of the decoded images may falsely give the impression of movement from one image to the next. This is

also referred to in the application as "apparent" movement of the still pictures.

By way of example, applicants recite in claim 1, a method for encoding a sequence of video frames (raw data) comprising for each frame of the sequence of video frames:

> encoding the frame employing at least one controllable parameter; and
>
> adapting the encoding of the frame when the frame is a **still frame, the still frame comprising a frame with content substantially identical to content of a preceding frame,** the adapting including adjusting the at least one controllable parameter employed in encoding the still frame to **minimize after decoding thereof, visually perceptible pulsation artifacts,** between still frames of a sequence of still frames within the sequence of video frames (i.e., raw data). The still frame being encoded comprises one still frame of the sequence of still frames.

In accordance with applicants' invention, a determination is first made that a still frame in a sequence of still frames in a series of video frames has been received at the encoder. The independent claims have been amended herein to specifically recite that a still frame comprises a frame with content substantially identical to content of a preceding frame. Thus, a sequence of still frames comprises a special case within a sequence of frames wherein there is little or no motion from one frame to the next. Applicants then adapt encoding of that still frame in order to minimize subsequently occurring visually perceptible pulsation artifacts between that still frame and an adjacent still

frame after the frames have undergone encoding and decoding. The problem addressed by the present invention exists when a series of identical or nearly identical still frames are encoded and then decoded for display. When such frames are displayed, visually perceptible "pulsation artifacts" may occur. The present invention thus seeks to minimize these pulsation artifacts which would otherwise occur after decoding of an encoded still frame by adjusting the at least one controllable parameter employed in the encoding of that still frame.

The Office Action cites Reininger et al. (5,426, 463) in view of Yanagihara et al. (5,321,440) as allegedly rendering obvious the independent claims of applicants' invention (i.e., claims 1, 19, 23, 34 & 37). This conclusion and the characterizations of the teachings of Reininger et al. and Yanagihara are respectfully traversed.

Reininger et al. describe a multi-pass encode system which uses the number of bits produced from encoding a macroblock as feedback to change the quantizer used on the same macroblock in the same frame in a next encode pass. If the number of bits produced for a macroblock on a pass is greater than a threshold number, then the quantizer is changed for a next encode pass.

Initially, Applicants note that Reininger et al. do not address or discuss the same problem as that to which the present invention is directed. A careful reading of Reininger et al. fails to uncover any discussion of

processing still frames, let alone recognizing the pulsation artifact problem addressed by Applicants, or Applicants claimed solution to the problem. Reininger et al. address the uniformity of image quality by limiting the amount of compressed data produced by the encoding process. Applicants' invention, however, is directed to minimizing visually perceptible pulsation artifacts occurring in a sequence of still frames which are displayed after undergoing encoding and decoding of the identical frames.

As used in the present application, a still frame is any frame in a series of received video frames that is, e.g., identical in visual appearance to the previous and/or next frame. Therefore, when the images are displayed, the visual appearance should remain constant from one frame to the next notwithstanding the encode and decode processing of the data which has occurred.

In contrast, Reininger et al. disclose a system for encoding video data which includes calculating the bits produced and encoded (i.e., compressed) for macroblocks within a single frame, and using this information as feedback for further refinements in the encode process. Reininger et al. determine the number of bits produced for macroblocks within a frame, and if the size is too large, then the quantizer is changed for the subsequent encode pass. Essentially, Reininger et al. disclose a constant bit rate encode process which seeks to maintain picture quality without violating the constant bit rate. To accomplish this, Reininger et al. evaluate the same picture in

compressed data format multiple times. (See column 4, lines 3 et al). Applicants respectfully submit that this process of Reininger et al. is substantially different from Applicants' recited processes.

In the Office Action, the Examiner essentially alleges that any frame in a sequence of frames comprises a "still image" and therefore comprises a "still frame" as the phrase is employed in the present application. This characterization of the prior art and application thereof to the problem addressed by the present invention is respectfully traversed. Each of the independent claims presented herewith has been amended to define that "still" refers to a frame or macroblock that has substantially the same content to the preceding frame or macroblock in a series of frames. Thus, the still frame or macroblock has minimal pixel difference from one frame to the next. It is the existence of such still frames which gives rise to the problem addressed by the present invention. Not every frame in a group of frames necessarily comprises a still frame as the phrase is defined in the independent claims presented herewith. Typically, there is motion (i.e., change) from one frame to the next in a sequence of video frames. If there is motion from one frame to a subsequent frame, the frames necessarily do not comprise still frames as defined in the present application.

To summarize, Applicants are addressing a problem unique from that of Reininger et al. Specifically, Applicants seek to minimize visually perceptible pulsation

artifacts which occur in a displayed video stream after the stream has undergone encoding and decoding processes, and in particular, which occur where the stream contains a series of still frames. Reininger et al. does not address or even discuss the existence of a series of still frames within a sequence of video frames, nor does the patent address the problem of visually perceptible pulsation artifacts occurring upon displaying a sequence of still frames which have undergone encode and decode processes. Applicants' invention comprises a technique for minimizing pulsation artifacts by adjusting the encode process of the frame as soon as the frame is identified to comprise a still frame. Applicants respectfully submit that a careful reading of Reininger et al. fails to uncover any teaching, suggestion or implication to one skilled in the art of such a technique.

The Office Action recognizes that Reininger et al. does not appear to disclose the limitation of "minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of a sequence of still frames". However, the teachings of Yanagihara et al. are cited to address this deficiency. Specifically, the Office Action alleges that the jitter discussed in Yanagihara et al. equates to the "pulsation artifact" defined by applicants in the independent claims presented herewith. The Examiner's use of "pulsation artifact" as a substitution for "jitter" in the Yanagihara et al. discussion is respectfully traversed.

As understood by one skilled in the art, the word "jitter" refers to and arises from pictures or frames being displayed out of their temporal order. Essentially, the display of frames is jumping forward and backward, for example, due to an error which may have occurred during the transmission of the frames. For example, jitter would be defined as displaying a first frame, a fourth frame, then a second and third frame, followed by a fifth frame. In contrast, the phrase "pulsation artifacts" is understood in the art and defined in the present application to mean visually perceptible pulsations which may occur in a sequence of still frames which have been displayed after undergoing encoding and decoding of the identical frames.

Additionally, a careful reading of Yanagihara fails to uncover any teaching, suggestion or implication of a process for adapting encoding of a frame when the frame is a "still frame" as discussed above and defined in the independent claims presented herewith.

For all the above reasons, applicants respectfully request reconsideration and withdrawal of the obviousness rejection to independent claims 1, 19, 23, 34 & 37 based upon the teachings of Reininger et al. in combination with Yanagihara et al. The dependent claims are believed allowable for the same reasons as the independent claims from which they depend, as well as for their own additional characterizations.

No new matter is added to the application by any amendment presented herewith.

The claims are believed to be in condition for allowance and such action is respectfully requested.

Should the Examiner wish to discuss this case with applicants' attorney, please contact applicants' attorney at the below listed number.

Respectfully submitted,

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Marked-Up Version of Claims

1. (Twice Amended) A method for encoding a sequence of video frames comprising for each frame of the sequence of video frames:

(a) encoding said frame employing at least one controllable parameter; and

(b) adapting said encoding (a) of said frame when said frame is a still frame, said still frame comprising a frame with content substantially identical to content of a preceding frame, said adapting including adjusting said at least one controllable parameter employed in encoding said still frame to minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of a sequence of still frames within said sequence of video frames, wherein said still frame comprises one still frame of said sequence of still frames.

19. (Twice Amended) A method for encoding a frame of a sequence of video frames, said frame having a plurality of macroblocks, said method comprising for each of at least some macroblocks of said plurality of macroblocks:

(a) encoding said macroblock employing at least one controllable parameter; and

(b) adapting said encoding of said macroblock when said macroblock is a still macroblock, said still

macroblock comprising a macroblock with content substantially identical to content of a corresponding macroblock in a preceding frame, said adapting including adjusting said at least one controllable parameter employed in encoding said still macroblock to minimize after decoding thereof, visually perceptible pulsation artifacts between corresponding still macroblocks of adjacent frames in said sequence of video frames.

23. (Twice Amended) A system for encoding a sequence of video frames comprising:

a pre-encode processing unit, said pre-encode processing unit comprising:

a statistics measurement unit for use in determining whether a current frame of the sequence of frames comprises a still frame, said still frame comprising a frame with content substantially identical to content of a preceding frame;

a control unit for modifying at least one controllable parameter employed in encoding said still frame to minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of a sequence of still frames when said statistics measurement unit determines said current frame to comprise said still frame; and

an encoding engine for encoding said current frame of the sequence of video frames using the at least one controllable encode parameter set by said pre-encode processing unit.

34. (Twice Amended) A system for encoding a macroblock of a plurality of macroblocks of a frame in a sequence of video frames, said system comprising:

an encoding engine for encoding said macroblock of said frame using at least one controllable encode parameter; and

means for adapting said encoding of said macroblock when said macroblock is a still macroblock, <u>said still macroblock comprising a macroblock with content substantially identical to content of a corresponding macroblock in a preceding frame,</u> said adapting including means for adjusting said at least one controllable parameter employed in encoding said still macroblock to minimize after decoding thereof, visually perceptible pulsation artifacts between

corresponding still macroblocks of adjacent frames in said sequence of video frames.

37. (Twice Amended) A computer program product comprising a computer usable medium having computer readable program code means therein for use in encoding a sequence of video frames, said computer readable program code means in said computer program product comprising for each frame of the sequence of video frames:

computer readable program code means for causing a computer to affect determining whether said frame comprises a still frame, said still frame comprising a frame with content substantially identical to content of a preceding frame;

computer readable program code means for causing a computer to affect encoding said frame employing at least one controllable encode parameter; and

computer readable program code means for causing a computer to affect adapting said encoding of said frame when said determining determines said frame to be said still frame, said adapting including adjusting said at least one controllable parameter employed in encoding said still frame to minimize after decoding thereof, visually perceptible pulsation artifacts between still frames of a sequence of still frames within said sequence of video frames, wherein said still frame comprises one still frame of said sequence of still frames.